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Citation for final published version:

Mandal, Anthony ORCID: <https://orcid.org/0000-0001-5719-6145> 2017. Digital humanities. Year's Work in Critical and Cultural Theory 25 (1) , pp. 374-397. 10.1093/ywcct/mbx020 file

Publishers page: <http://dx.doi.org/10.1093/ywcct/mbx020>
<<http://dx.doi.org/10.1093/ywcct/mbx020>>

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Digital Humanities

ANTHONY MANDAL

Digital technologies continue to entangle themselves more deeply in our everyday lives in various ways; however, two key aspects can be seen as particularly dominant: an increasing recognition of the *materiality* of the digital and the role of ‘big data’ in controlling—indeed, structuring—us. The emergence of ubiquitous computing in the form of the Internet of Things that connects devices and their users physically within cybernetic networks can be seen through the increasing popularity of wearable devices and ‘smart’ home technologies. Meanwhile, the operations of big data continue to reconfigure human subjects into ‘users’, defined by quantification and shaped by algorithmic processes. Undergoing such datafication, we are interpellated—often voluntarily, occasionally through coercion—into systems that leave us prone to surveillance by corporations, governmental agencies and cybercriminals. Recent macro-events—the crippling cyberattack on the UK’s National Health Service (May 2017), the catastrophic outage of British Airways’ IT infrastructure (May 2017) and the shadowy role played by data mining/analysis companies in the US Presidential Election and Brexit Referendum in the second half of 2016—have demonstrated how vulnerable today’s digital citizens are. This chapter considers seven publications from 2016 that reflect these concerns with materiality and datafication in various ways, first surveying three major essay collections that seek to explore longstanding issues or stimulate new reflections on our immersions within digital culture. Discussion then moves to examine ‘media archaeological’ approaches to computing, in Matthew Kirschenbaum’s literary history of the word processor and Tung-Hui Hu’s prehistory of the cloud—both offering new insights into everyday computational technologies that provoke a reconsideration of our interactions with them. The chapter then turns to quantification, by examining Deborah Lupton’s analysis into the ways

in which digital self-tracking has coalesced around the Quantified Self movement, and to the risks to our lives and liberties through the increasing dominance of big data in analysing and controlling social policy interrogated by Cathy O’Neil.

A dozen years after the publication of the original collection that is heralded as giving digital humanities (DH) their name, 2016 saw the publication of *A New Companion to Digital Humanities*, edited by Susan Schreibman, Ray Siemens and John Unsworth. As I noted in my chapter last year, the original *Companion to Digital Humanities* (Blackwell [2004]) proffered the academy a wider cultural relevance for DH beyond the tools development and text markup that had dominating the emergent field of ‘humanities computing’, as it was then known. Reflecting on developments in the intervening decade, the editors comment:

It remains debatable whether digital humanities should be regarded as ‘a discipline in its own right,’ rather than a set of related methods, but it cannot be doubted, in 2015, that it is a rapidly growing field of endeavor. [. . .] What is important today is not that we are doing work with computers, but rather that we are doing the work of the humanities, in digital form. (p. xvii)

The new volume is divided into five complementary parts that seek to span, in thirty-seven essays, the contours of DH scholarship. Part I, ‘Infrastructures’, explores physical computing and fabrication, embodiment and immersion, the Internet of Things, and collaboration. The second part, ‘Creation’, examines various phenomena, ranging from electronic literature to gamification, from virtual world-building to retrocomputing. Notably, the largest section of the *New Companion* is the third, ‘Analysis’: as well as more conventional approaches, recent trends and developments are given due consideration. Essays explore not only data modelling and the mining, encoding and classification of treats, but the geospatial turn, engagements with music and audio, graphical approaches to the DH and digital materiality. Part IV, ‘Dissemination’, surveys the significance of interface and software design, the role of

academic procedures such as peer review in assessing DH outputs, issues of preservation and developments in crowdsourcing academic research activities. The collection concludes with a section on ‘Past, Present, Future of Digital Humanities’, a series of reflections by leading scholars in the field on issues ranging from administration of the DH, globalization, gendering digital literary history and the contested nature of digital scholarship. As William G. Thomas III notes, the promise of the DH is that they have the potential to disrupt the conventions and traditions of traditional humanistic practices in productive ways: ‘Because criticism has been based on fixity, the fluidity and reciprocity at the heart of the digital environment’s affordances suggest that traditional mechanisms of review no longer apply’ (p. 535).

Finn Arne Jørgensen’s ‘The Internet of Things’ captures the increasingly *material* aspects that can be brought to bear when discussing the digital world, as our so-called smart electronic devices (watches, homes, cars, cities) increasingly communicate with each other, bridging the real and digital worlds. Yet, no new technology can sit apart from its precursors, both materially and politically, as Jørgensen admonishes: ‘The underlying standards and use patterns of the Internet of Things will most likely reflect the boundaries and power relationships as the rest of the world. [. . .] When something becomes ubiquitous and pervasive, it also becomes invisible and taken for granted’ (p. 51). A better understanding of such complex entanglements with digital media can be secured through ludic encounters, within which creative processes can be leveraged for critical outcomes, as suggested in Steven E. Jones’s ‘New Media and Modelling: Games and the Digital Humanities’: ‘layered, engaged play at the circumference of a socially delineated gamespace begins to look a lot like hermeneutic engagement in general, once we understand interpretation as a playful, ludic activity’ (p. 88). Jones goes on to argue that video games can be especially useful to the DH as simulation systems that allow modelling *of* and *for* narrative possibilities (p. 91). Despite

the continuing dominance of text-driven research in the DH, recent work is increasingly turning towards visual paradigms in a number of ways. Todd Presner and David Shepard's 'Mapping the Geospatial Turn' opens with the observation that 'mapping, geo-temporal visualization, and locative storytelling' have exploded as subfields with the DH (p. 201). Indeed, there has been a proliferation of DH research that utilizes a range of geospatial technologies, ranging from conventional on-screen mapping, such as *LitLong: Edinburgh* (<http://litlong.org>) and *Mapping the Republic of Letters* (<http://republicofletters.stanford.edu>), to locative and ambient experiences that immerse their participants psychogeographically within the landscape, as in the *StoryPlaces* (<http://storyplaces.soton.ac.uk>) and *Ambient Literature* (<http://ambientlit.com>) projects. This kind of work stretches beyond the purely explicative or phenomenological, as Presner and Shepard make clear:

Unlike conventional approaches to mapping, which tend to be positivistic and mimetic, the digital humanities has imagined critical practices of geo-temporal narration, forms of counter-mapping, and notions of 'deep mapping' or 'thick mapping,' which privilege experiential navigation, time-based approaches, participatory mapping, and alternative rhetorics of visualization. (p. 207)

It is this critical point that Johanna Drucker picks up in 'Graphical Approaches to the Digital Humanities', arguing that visualization is central to the DH, which have so far 'adopted conventions of information visualization and user interface that come from disciplines whose epistemological premises are fundamentally at odds with humanistic methods' (p. 238). Drucker challenges the push towards quantification that has characterized the DH as alien to the traditions of humanistic enquiry: "'data" are antithetical to humanistic artifacts, they are fundamentally different in nature from the artifacts from which they are derived' (p. 246). Drucker's solution to such epistemological positivism is to develop interfaces that visual deploy the complexities of human experience and knowledge: 'point-of-

view systems, partial knowledge representation, scale shifts, ambiguity, uncertainty, and observer dependence' (p. 248). By contrast, Matthew L. Jockers and Ted Underwood's 'Text-Mining the Humanities' emphasizes quantification as a useful tool for unlocking new insights into textual corpora. Jockers's research builds on Franco Moretti's notions of 'distant reading', applying various computational methods to analyse literary patterns divined from hundreds if not thousands of texts: most notably realized in his controversial study, *Macroanalysis: Digital Methods and Literary Analysis* (UillinoisP [2013]). Pointing to a longstanding tradition of quantification within the humanities, Jockers and Underwood argue that 'humanistic text mining seeks to frame questions the contribute meaningfully to existing traditions of humanistic inquiry' (p. 293), emphasizing the interdisciplinary approaches that underpin such work. The time for a sustained interrogation of our cultural inheritance has never been better, according to the authors, as '[a]t no time in history have we every had such access to the written record, [. . .] mark[ing] a moment of great promise and great progress' (p. 302).

Large datasets need not simply lead to analysis by individual researchers, but can themselves be the fruit of the increasingly collaborative models of scholarship encouraged by the affordances of Web 2.0 technologies. Melissa Terras's 'Crowdsourcing in the Digital Humanities' considers the ways in which communities of volunteers can enact epistemic shifts in our relationship to cultural artefacts. Academic projects like *Transcribe Bentham* (<http://blogs.ucl.ac.uk/transcribe-bentham/>) and *Old Weather* (www.oldweather.org), as well as resources aimed at the general reader like *Wikipedia*, have yielded impressive outputs in a relatively short space of time, by building on the 'wisdom of the crowd'. Yet, the political ramifications of such enterprises in the 'knowledge economy' are far from straightforward: 'Institutions and scholars planning on tapping into the potential labor force crowdsourcing offers have to be aware of the problems in outsourcing such labor, often very cheaply, to low-

paid workers, often in developing countries’ (p. 433). Such political implications of the DH are interrogated in ‘Only Connect: The Globalization of the Digital Humanities’ by Daniel Paul O’Donnell *et al.*: ‘it is for the most part the case that our international and collaborative activity [in the DH] is conducted along a primarily east–west axis among a relatively small number of mostly contiguous high-income economies in the northern hemisphere’ (p. 493). In particular, the dominance of ‘Anglo-American research norms, genres, and interests’ over non-anglophone traditions and regions has resulted in endemic asymmetries within the DH—something that a number of contributors to the *New Companion* seek to challenge.

Another updated collection from 2016 is Wendy Hui Kyong Chun and Anna Watkins Fisher’s *New Media, Old Media: A History and Theory Reader*, originally published in 2006. This volume offers nearly fifty essays that theorize the operations of media in the digital age, bringing together excerpts from landmarks works and specially commissioned pieces. The collection is divided into seven sections, each of which seeks to inflect the mutable and polyvalent nature of ‘new’ media: ‘Archaeology of Multi-Media’, ‘Archives’, ‘Power-Code’, ‘Network-Events’, ‘Use’, ‘Desiring Data’ and ‘Re-Newing Media’. Unsurprisingly, there is a strong media archaeological inflection to the collection, which includes offerings from key commentators in the field, such as Vannevar Bush, Wolfgang Ernst, Lisa Gitelman, Matthew Kirschenbaum, Friedrich Kittler, Lev Manovich and Jussi Parikka. Given the size of the collection, it is impossible to summarize its contents concisely or to select a representative sampling of the rich pickings assembled by the editors. Instead, I have confined my discussion to the editors’ incisive introductions to the volume and its constituent sections. Chun opens by pointing to the ubiquity of new media, while seeking to dig deeper into its substrates to reveal a far richer history than the term itself rather unhelpfully (in the editors’ eyes) captures: ‘From criticism of cyber-utopianism to early predictions of the dot.com

meltdown, new media have teetered on the bleeding edge of obsolescence. To call something new is to guarantee that it will one day be old' (p. 1).

Although it has a history stretching back to the 1960s, the term 'new media' began to be employed in earnest in art and business during the mid-1990s, displacing the perhaps more open designation of 'multi-media'. Chun locates a tension at the heart of this adoption. In the commercial sector, the term was galvanized by its own hyped 'newness' and revolutionary potential, but its decline was equally as precipitous as its rise, particularly in the wake of the burst dot.com bubble around 2001. By contrast, in academia new media studies enjoyed a lesser decline owing to an agnosticism that situated it somewhere between 'commercial propaganda and scholarly conservatism' (p. 2). Chun defines the terms of reference for the collection by pointing to landmark work by Jay David Bolter and Richard Grusin, Manovich, Gitelman, and Noah Wardrup-Fruin and Nick Montford. However, she disturbs the stability conventionally afforded to both terms 'new' and 'media', while resisting the underlying assumptions of these earlier studies that connected new media intrinsically to computation. Briefly working through the history of the terms 'medium', 'mediums' and 'media', as well as citing Kittler's foundational work, Chun marks the rise of new media as, if not a rupture, then 'an important discontinuity' linked to mass media or mass circulation. While eschewing a historicist teleology or unifying holism, the collection seeks to draw together approaches and schools of thought that have typically been discrete. In so doing, *New Media, Old Media* challenges the presentism that often adheres to the discourses surrounding new media: 'This collection [. . .] seeks to shake loose current intellectual trajectories and common-sense understandings of new media—what it was, what caused it to be, what it will become' (p. 15).

Chun's general introduction is supplemented by concise, helpful commentaries by her fellow-editor, Fisher. The essays complicate Foucault's linkage of archaeology to a notion of archive as system in *The Archaeology of Knowledge* (1969), by positing computers as 'the

exemplary multi-media archive, even as they call into question the very concept of the archive' (p. 19), as well as reaffirming the importance of 'old media' (the telegraph, film, photography, television) to digital technologies. In seeking to do this, the dialogue that emerges from and between the essays enquires 'how new media have opened up fissures between what is knowable and unknowable, what is seen and unseen' (p. 22). New media recast the 'archive fever' of the paper age—from 'the blatant issue of physical storage and labor' that preoccupied both Foucault and Benjamin in the previous century, 'to that of the ostensible abstraction of memory' (p. 144), which itself has itself is challenged by Kirschenbaum's materialist grammatology of inscription (as found, for example, on the surface of a computer's hard drive). The readings of the archive offered in the collection 'hold in tension the right to forget and the will to preserve. They explore how such concepts as storage and transmission, and access and delusion, are intimately intertwined' (p. 146). Complementing its readings of the archive, the volume moves on to explore how new media not only produce knowledge but are constituted by it, through an exploration of the power relations that adhere to 'code' (i.e. programming languages). Reflecting what is now termed 'Critical Code Studies', the essays situate the early history of code as an outgrowth of the Cold War, as the computer transformed from an analytical engine into a communicative device, positioned within the wider socio-cultural dynamics of economic policy, the growth of labour movements and the discourses of race and gender. The language employed by the contributors when discussing code is itself revealing, as they invoke terminology such as 'priesthood', 'control', 'viruses' and 'parasites' when articulating the relationship between code and society.

Building on French theorist Paul Virilio's concept of the 'shrinking effect' consequent upon modern communication technologies (*The Art of the Motor* (UMinnesotaP [1995]) p. 35), Watkins discusses how the collection also 'interrogate[s] the relationship of

information to economies of time and space. It asks: how are events mediated, and how is mediation experienced as an event? That is, how are networks sensed or felt—as anxiety, excitement, bewilderment?’ (p. 303) As other studies discussed in this chapter show, the emergent algorithmic basis of modern society generates a new subjectivity grounded in ‘datafication’: the political consequences of this process are that those algorithms remain ‘black-boxed’, sealed off from interrogation. This yields occlusions and imbalances across various axes of gender, race, wealth and class—something which the essays in *New Media, Old Media* seek to surface. For instance, we might consider how ‘new media technologies are complicit with the system of neoliberal debt’ (p. 304), themselves growing out of nineteenth-century capitalist exploitation of labour (through enslavement and mechanization). Similarly, the positivist futurology associated with new media can render their underlying power structures discursively opaque or distorted, meaning that ‘[w]e often fail to recognize the ambiguous power that technology endows, because we fetishize it and view media effects as unmediated by linguistic and sensory histories’ (p. 305).

One solution to such occlusive tendencies may lie in a knowingly ‘participatory’ approach—the prosumption/produsage model advocated by media theorists like Henry Jenkins and Axel Bruns, among others (see last year’s chapter for more about prosumption). Participatory media enable users to co-opt and occupy the power structures from within, offering opportunities for reassertion of subjective identities and radical ‘hacktivism’. Nevertheless, even participation brings its own costs: essays in the collection offer us both the optimistic and pessimistic readings of the political economies of participatory media.

Some essays ask how ubiquitous computing has eroded the distinction between work and play: while Tiziana Terranova cautions us to be suspicious of user-generated content as symptomatic of a complex and seductive new labor formation, danah boyd is enthusiastic about the pleasurable sociality of the ‘always-on’ lifestyle, calling instead for a

framework for conceiving of ‘use’ as something other than mere exploitation or addiction.

(p. 404)

Of course, part of the risk is that ‘use’ can lead to a desire that further entangles us within (both older and emergent) hegemonic structures of surveillance, so that ‘notions of consent and participation are being transformed, and indeed distorted’ by new media (p. 511). In fact, as a contribution by Jean Baudrillard notes, disempowerment might come not from a lack of information, but from the information itself—even an excess of it. Indeed, we find ourselves interpellated into these algorithmic subjectivities in a number of ways, so for example, ‘the coercive power of Facebook is structured through the threat of social invisibility’, while ‘Google’s “choice architecture” works through default settings that privilege maximum exposure’ (p. 513). An impressive and apposite collection, *New Media, Old Media* concludes with essays that reframe ‘critical, historiographical, and disciplinary conceptions of the “new” in new media’ in a number of ways. Some examine how seemingly obsolete media (‘old media’) have resurfaced or been reinvigorated in surprising ways, while others disclose how the apparently ‘new’ media object ‘is rooted in the very past that it actively disavows’, bringing us recursively back to the collection’s opening section on ‘media archaeology’. In the world of new media, archaeologists and futurologists both agree that we operate at an event horizon that brings all media—past, present and future—into sharp relief.

The success of *Debates in the Digital Humanities* (UMinnesotaP [2012]), a compendious collection of provocations edited by Matthew Gold, has led to a 2016 volume, co-edited by Gold and Lauren Klein. The editors begin by reflecting upon the elasticity of the term ‘digital humanities’, which might itself be problematic. If the organizing principle driving the 2012 collection had been whether the DH could be framed as an inclusive field of practice (so-called ‘bit tent’ DH), the 2016 volume intends to complicate this model. Drawing on art historian Rosalind Krauss’ work, the editors consider whether the DH can be reconfigured as

an ‘expanded field [. . .] constructed by the relationships among key concepts, rather than by a single term’ (p. x). The editors signal ‘the challenges currently associated with the digital humanities involve a shift from congregating in the big tent to practicing DH at a field-specific level, where DH work confronts disciplinary habits of mind’ (p. xi). In the light of this, *Debates* will operate as an annual series that highlights ‘the particular debates that have shaped the field in a given year, to be published in both interactive online and traditional print forms’, pairing essays, blogs, conference presentations, interviews and position statements (p. 569). The forty-nine essays in the volume inflect this revised understanding of the DH by exploring their intersections with a range of other fields, such as archaeology, art history, book history, black studies, gender studies, history, literary history and queer studies. The 2016 volume is divided into six sections that consider various aspects of the DH: Histories and Futures, Methods, Practices, the Disciplines, Critics and a ‘Forum’ that discusses ‘Text Analysis at Scale’.

Steven E. Jones’ ‘The Emergence of the Digital Humanities (as the Network Is Everting)’ begins by noting the shift over the last decade in digital networks, from cyberspace into physical world, through a process described as ‘eversion’ by the science fiction novelist William Gibson. For Jones, the term ‘articulates something significant about a recent shift in the collective understanding of the network: from a world apart to a part of the world, from a transcendent virtual reality to a ubiquitous grid of data that we move through every day’ (p. 3). In the parlance of media theory, then, eversion traces our transition from earlier models of virtual reality configured as ‘cyberspace’ towards a ‘mixed reality’ that fluidly merges digital networks and physical spaces through augmented reality, locative media and surveillance. Jones also observes that it was around the time of this transition (2004–8) that the DH underwent their own eversion, gaining increased public exposure. As noted earlier in this chapter, this process was marked most tellingly by the shift from ‘humanities computing’

to ‘digital humanities’, which itself acknowledged a mixed reality that incorporated the digital with the material (manuscripts, books, documents, maps, works of art) (pp. 4–5). This notion of the digital and humanistic as contiguous modes is picked up later in the collection: ‘Putting the Human Back into the Digital Humanities: Feminism, Generosity, and Mess’ by Elizabeth Losh *et al.* The essay builds on their work as part of FemTechNet, which—having identified a discursive blindspot in the DH—seeks to build critical literacies based on an understanding of ‘technologies as complex systems with divergent values and cultural assumptions’ (p. 92). Ongoing feminist work is addressing prevalent, typically masculinist, ‘biases toward imagined technocratic rationality in the digital humanities’ (p. 93). Feminist scholars can rescript the narrative of the DH by interrogating the ways in which datasets and computational processes embody social hegemonies, by challenging online misogyny and racial profiling, and by exposing discourses of ‘niceness’ that mitigate opportunities for diversity, equity and inclusion. Aware of the mediated nature of the digital world and its artefacts, the authors contend:

It is vital to attend to how corpora composed of supposedly neutral and transparent databases and tools may obscure the many ways that objects of study are positioned in relationship to human—and race, classed, and gendered—constructs of discovery, revelation, display, exhibition, desire, curation, witnessing, and bearing witness. (p. 99)

Correspondingly, Kim Fallon’s ‘Making a Case for the Black Digital Humanities’ observes that ‘discussions about the lineage of Black studies within the digital humanities are almost non-existent’ (p. 42). Fallon advocates that the ‘technology of recovery’ underpinning black digital scholarship can ‘help to unmask the racialized systems of power at work in how we understand the digital humanities as a field’ (p. 43), notwithstanding the ways in which computational processes seek to construct alternative human modalities. Enlarging the DH with sociocultural meaning, black DH can provide a forum for scrutinizing narratives of race,

technology and biopolitics—‘dismembering how we think about humanity and the digital humanities by extension’ (p. 47).

In his provocative essay, ‘Digital History’s Perpetual Future Tense’, Cameron Blevins interrogates the persistence in the framing of DH approaches to history as always ‘new’, full of ‘promise’ and offering great ‘potential’ (p. 308). Blevins argues that while digital history has clearly ‘arrived’, such emphasis hides a larger occlusion when it comes to interception and argumentation: ‘In terms of using technology to advance academic claims about the past, digital history has largely overpromised and underdelivered’ (p. 309). The emphasis on methodology over theory, while inclining towards a revitalized focus on empiricism in the humanities, can generate equally problematic lacunae in disciplines where ‘[a]rgumentation is the fulcrum’. As a result, digital history has moved away from the academy, so that many ‘conversations are centered on libraries, museums and classrooms. Digital historians have contributed far more to public history than we have to argument-based scholarship’ (p. 319). Notwithstanding the need to re-engage with the traditional vectors of humanistic enquiry, Sheila A. Brennan’s ‘Public, First’ conversely emphasizes the need for a ‘public digital humanities’, which ‘engages with communities outside of the academy as a means for doing digital humanities scholarship’ (p. 384). Brennan traces the long trajectory of public history in the US back to the early nineteenth century, beginning with community volunteers who preserved their stories, before the involvement of federal government from the late nineteenth century onwards and then the role played by academic and public historians in the twentieth. Building on this tradition, Brennan argues that today’s scholars need to identify and collaborate with specific audiences for their digital projects, reaching beyond a generalized (and thereby distanced) concept of ‘the public’ as the ‘other’ to our academic labours. Instead, DH practitioners should incorporate and invite voices from user communities from start to finish, so that research is co-produced and shaped from the grassroots upwards.

Mark Sample's 'Difficult Thinking about the Digital Humanities' returns to the controversy sparked by Adam Kirsch's jeremiad, 'Technology Is Taking Over English Departments: The False Promise of the Digital Humanities', which I discussed in last year's chapter. Offering a rejoinder to an earlier essay by Sample, Kirsch argued that '[i]t makes no sense to accelerate the work of thinking by delegating it to a computer when it is precisely the experience of thought that constitutes the substance of a humanistic education' (*New Republic* [2 May 2014] <<https://newrepublic.com/article/117428/limits-digital-humanities-adam-kirsch>>). In 'Difficult Thinking', Sample rejects Kirsch's technophobia as an example of 'facile thinking [which] ignores contradictory evidence, dismisses alternative ways of seeing, and generally places its critiques of the digital humanities' for various reasons, none of which have to do with the digital or humanities: sensationalism, opportunism or sincere (but misdirected) criticism (p. 511). In response, Sample calls for 'difficult thinking' (Alan Liu terms it 'cultural criticism'; Fred Gibbs, 'critical discourse') in the DH (p. 512) based on evidentiary-based reasoning, alternative perspectives and unresolvable dilemmas to stimulate a kind of 'rational empathy'. This notion of empathy recurs in Stephen Ramsay's 'Humane Computing', which admonishes that DH practitioners operate 'within the context of humanistic inquiry. Here, the conversation is about the nature of the human condition and its artistic and historical artifacts' (p. 527). One can sense a riposte to the likes of Kirsch, when Ramsay characterizes fears about an empiricist tyranny driven by the quantification of the humanities and computational positivism as 'grossly overblown' (p. 528). Instead, he argues, the DH must be embraced as part of humanistic enquiry, as humanists are highly equipped not only to interpret data formulations but to question them as well:

The choice we face is therefore not between scientism and humanism, but between a willingness to allow digital objects—including those that deal with empirical data—to

participate fully in humanistic discussions according to the terms of those discussions, and a dismissal of digital work as inherently incompatible with those discussions (p. 528). Margaret Linley's 'Ecological Entanglements of DH' suggests an even wider application of such humane approaches, by pointing to new cultural processes that construct the digital imaginary in a way that 'builds on and extends the connectivity and continuity analyzed in frameworks developed through modern environmental thought and the media ecology tradition' (p. 410). Linley's essay explores the different permutations that an 'ecological' approach to the DH might and do take (political ecology, media ecology, nature's economy, ecosystems and mutations), in order to suggest that this kind of thinking 'pushes against our humanist reluctance about new ways of creating meaning through human-machine collaborations of simulation, modeling, and probabilistic topologies', calling instead for an 'ethical awareness' (p. 428).

Matthew Kirschenbaum's *Track Changes: A Literary History of Word Processing* reveals an unexpected depth and complexity to one of the most ubiquitous, yet overlooked, modern writing technologies. Applying a media archaeological approach, Kirschenbaum draws on a range of primary materials, among them advertisements, magazine articles, personal correspondence and memoirs. The result is a compelling and evocatively detailed history that explores the synergistic relationship between technology and literature. Kirschenbaum observes how

Many of us must imagine that its present-day ubiquity was somehow preordained, the trajectory of its uptake as smooth as the convex curve of a classic CRT screen. And indeed, word processing's standard narrative possesses an overwhelming sense of inevitability. (p. 15).

In order to disrupt this teleological perspective, *Track Changes* challenges the presentism of technological discourse to explore the materiality of word processing, framing it within the

complex history of writing. Along the way, Kirschenbaum also answers some intriguing questions: When did the term ‘word processing’ first come into usage? What was the first novel written using modern word processing technologies? Who was the first novelist to use the word processor as we recognize it today? Centring on the years 1964–84, *Track Changes* interweaves brief, but illuminating, accounts from a number of authors, ranging from genre writers to experimental innovators.

Track Changes makes clear that the history of word processing is somewhat removed from a ‘virtual’ or ‘digital’ imaginary. Instead the scene of writing is to be found in a hybrid world of technological innovation, economic developments and gender politics: ‘the quest for flawless efficiency and efficiently flawless results [. . .] was present from the very inception of word processing as a concept and technology’ (p. 34). On the one hand, a word-processed manuscript could be delivered as a finished object, marked by a ‘perfection’ unmarred by messy corrections or deletions. The ‘self-healing’ nature of the word processor’s surface redefined writing, moving it from its origins in inscription towards algorithmic manipulation, generating a ‘strange new ontology’ that ‘lifted written language into symbolic, procedurally actionable realm, coupled with the inscrutable opacity of the physical apparatus working the magic’ (p. 85). If word processing enabled authors to write faster, ‘it also inaugurated its own attendant labor regimen’, from learning to operate the computer to routine maintenance of the system’s components (p. 101). On the other hand, ‘processing’ suggested a commodification and automation of words, making text seem more akin to computer code than the reification of thought. This emphasis on labour served as a source of anxiety for writers, complicating the auteur–drudge binary. In this sense, the prolific crime novelist James Patterson could be seen as another type of ‘word processor’, producing multiple formulaic works a year, most often with a series of ‘collaborators’ who develop full novels from his outlines—there is no coincidence, Kirschenbaum notes, in the rise in both word processing and bestseller lists. In

fact, the earliest mass adopters of word processors among authors were science fiction writers, such as Jerry Pournelle (1978), Bonnie MacBird (1979), Isaac Asimov (1981) and Arthur C. Clarke (1981). Computers connected through modems enabled Stephen King and Peter Straub to collaborate at distance between 1981 and 1983 on writing *The Talisman* (1984), involving them in devising a system to exchange and archive files that underpinned their writing process. According to Kirschenbaum, such practices attest ‘to a scene of writing that is invariably messier and more complicated than any medium-specific account would suggest’ (p. 62).

Word processors moved writers from inscribing words on paper with some degree of permanence to completing an electronic circuit between keyboard and screen, whose phosphors on glass screens generated an ‘aesthetics of luminescence’ characterized by speed and evanescence (pp. 45–6). Yet, for Kirschenbaum, the paradigmatic modality of the word processor is not that of the screen but ‘suspended inscription’, in which ‘the stored record of a text is separate from whatever the medium or surface on which it is ultimately printed or inscribed in more palpable form’ (p. 46). According to Kirschenbaum, the first word-processed novel, Len Deighton’s *Bomber* (1970), was composed on an IBM MT/ST using suspended inscription rather than glowing screen: text was entered via an electric typewriter and stored on magnetic tape, which could then be replayed and modified before being outputted by the typewriter. Thus, the MT/ST was a combination of the virtual and material, with magnetic tape forming the essence of the process, so the machine was the ultimate authority within a cybernetic circuit in which the author formed a node. Moving beyond materiality, Kirschenbaum locates the origins of word processing within the transforming gender politics of the professional sphere of the mid-1970s. Anxieties about the ‘social office’, characterized by free time and free mixing of the sexes, positioned such practices as wasteful and ‘promiscuous’, especially as far as regulation of female bodies was concerned.

The introduction of computer systems into the office *habitus* recalibrated their female operators (known as ‘word processors’) through algorithmic processes that controlled both human bodies and software actions. While word processing was quickly replaced by office automation in the late 1970s, its gendered fundamentals remained in place, and the stenographic (female) ‘body ha[d] become an interchangeable component in an integrated circuit, wired into the media apparatus from head to toe’ (p. 158).

If word processing grew out of the troubled gender politics of the 1970s and generated existential angst among contemporary writers, it presents both creative opportunities and scholarly challenges today. The culture of ‘overwriting’ ushered in by word processing has shaped works such as Bruce Sterling and William Gibson’s *The Difference Engine* (1990) and Jesse Kellerman’s *Potboiler* (2012), which employ overwriting as a literary technique. The Barbadian poet Kamau Brathwaite uses the typographical affordances of word processing to innovate his ‘Sycorax Video Style’, whose *mise-en-page* offered a ‘slow-time’ alternative to the accelerating ‘fast time’ of Western society. In more populist terms, Seth Grahame-Smith’s *Pride and Prejudice and Zombies* (2009) started with a copy of Austen’s original in a word processor, which the author then began to erase and transform—offering an example of the twenty-first-century ‘remix culture’ celebrated by Lawrence Lessig. More experimental work can be found in the algorithmic writings of Elizabeth Tonnard and the verbatim transcriptions of Kenneth Goldsmith, who calls himself a ‘word processor’ rather than a ‘writer’. At the same time, the overwriteable medium of the word processor threatens to disrupt, if not destroy, the precious textual traces generated by authors (manuscripts, proofs, annotations) of previous ages and later scrutinized by textual scholars. The digital thus poses challenges to posterity, particularly since it has become clear that digital media (magnetic, optical, mechanical, networked) degrade far more rapidly than their paper counterparts. Notwithstanding these lacunae, *Track Changes* offers some optimistic conclusions. Much as

in the age of print, manuscripts continue to coexist alongside digital artefacts, while computers themselves are increasingly being seen as important—both as writerly spaces and as ‘evocative objects’, to use Sherry Turkle’s term for artefacts on which we imprint our own affective ties (*Evocative Objects: Things We Think with* (MITP [2007])). Residual storage media, such as floppy disks, operate as ‘remnants or remainders’, ‘material artifacts as well as virtual totems’ (p. 220), generating both reassurance and doubt. As forensic recovery technologies improve, digital archives themselves raise various questions ‘concerning authorial intentions, personal privacy, intellectual property, and the ethical responsibilities of both individuals and institutions to collective cultural memory’ (p. 220). What Kirschenbaum makes clear is that the textual scholars and literary theorists of the future will need to familiarize themselves with the long history of computing if they are to understand authors’ *oeuvres*, and that we must combat the temptations of presentism to recognize word processing itself as a historical category:

Word processing was, for a time, something new, something different from writing; then, for a time, it was simply writing, threatening to eclipse everything that had come before it; now it is once again something to be self-consciously emulated and engineered with deliberation, a specialized app rather than an all-encompassing application. (p. 242)

Tung-Hui Hu’s *A Prehistory of the Cloud* offers another fascinating account of the internet and its precursors from a media archaeological perspective. While the ‘cloud’, spoken of in the singular, has been imagined as an immaterial and immanent non-place, Hu positions it as both an idea and an object: an ‘amorphous admixture’ (p. ix) of technologies, but also a sociopolitical displacement responsible for new structures of power. Drawing on Foucault’s and Deleuze’s work on the shifting models of power and biopolitics—from sovereign to disciplinary to control societies—Hu posits that cloud culture reintroduces a new form of sovereignty. The ‘sovereignty of data comes out of the way we invest the cloud’s

technology with fantasies about security and participation', through which the cloud's users are positioned within 'the same political economy as the acts of state violence performed in their name' (pp. xvi–xvii). This reading of violence and power lies at the heart of Hu's compelling analysis, which explores the construction of subjectivity in post-Cold-War economic liberalism in the form of the 'user'. Divided into four chapters, Hu's media archaeological approach takes the reader deeper through the layers of the cloud, from its most recognisable, abstract formulation (as a non-topological 'network of networks') to its most material (successively through time-sharing and virtualized computational practices, to data centres and data bunkers, and finally to the level of data and code). Hu's nuanced analysis of the cloud is supplemented by a range of case studies drawn from the Victorians to Cold War paranoia, in order to 'offer the potential for an alternate, reparative reading' of digital culture and its subjectivities (p. 34).

Challenging the globalized, non-topological view of the cloud, Hu begins by emphasizing how the perception of the cloud as immanent and displaced belies its hybridity: 'the cloud increasingly masks that sense of a shared space with plentitude, even though it is rooted in, and continuous with, the same landscapes, environments, and architectures that have been used for centuries' (p. 148). Instead, the Internet is better understood as a 'graft' (p. 7), as much of the new (optic fibre, virtual file storage) technology of the cloud is laid upon the old (railway tracks, data bunkers). The spatial characteristics of the cloud combine with temporal dynamics: Hu traces this phenomenon back to the early history of computing, which invented the concept of the 'user' through practice of 'time sharing' in the 1960s. Time-sharing technology shared out computational time by switching between different users' programs so rapidly that it appeared the computer was responding instantaneously to each user's commands. For Hu, a user's subject position was not merely created by software, 'but by the economic system that undergirds whatever relations any of us have with technology' (p. 39).

A similar system of ‘virtualization’ operates in the cloud today: although our personal interactions appear to be stored and retrieved discretely to meet our individual needs, in reality they exist contiguously with others’ in vast data stores located around the world.

Moreover, use of the cloud is itself governed by a kind of ‘network fever (p. 11):

Network fever is the desire to connect *all* networks, indeed, the desire to connect every piece of information to another piece. And to construct a system of knowledge where everything is connected is, as psychoanalysis tells us, the sign of paranoia. [. . .]

[N]etwork fever cannot be separate from the network, because the network is its fever.

The cloudlike nature of the network has much less to do with its structural or technological properties than the way that we perceive and understand it; seen properly, the cloud resides within us.

‘[T]he always unstable desire for the computer [. . .] creates the subject position we now call the user’ (p. 44), yet as with time-sharing the user’s desire is constructed in both intimate and economic terms, blending work and recreation together within the atomized neoliberal system. Virtualization suggests an intimacy and immediacy that offsets ‘waste’ (of one’s time, of computing resource), ensuring that we remain productive nodes within the economic circuit. Conjuring up images of illimitable air and water in its very description, ‘the cloud’ suggests an expansiveness and plenitude that exists at the level of abstraction, yet as Hu reveals, wastefulness lies at the heart of cloud computing: the cloud is, in fact, a resource-intensive, extractive technology that converts water and electricity into computational power with significant environmental implications.

Drawing on Virilio’s *Bunker Archaeology* (1975), Hu suggests that a neglected but fundamental aspect of the cloud lies in its physical rootedness in data centres: vast electronic bunkers that power the internet and are themselves often housed in former military or industrial sites. ‘[A] data bunker embodies a return to what is known as sovereign power, a

kind of explicit power rooted in territory rather than in more implicit methods of regulating a population' (p. 82). Cloud-use thus encourages a 'bunker mentality', which reconstitutes subjects engaged 'in a process of self-surveillance, constantly alert and on guard against improper behaviors' (p. 84). While espousing digital freedoms as allegedly universal, the actual networks of power invoke external enemies (such as terrorists, criminals, government agencies) in order to regulate domestic citizens, occluding the racial components and imperialist legacy of the structures and systems that undergird the cloud. Hu warns that '[d]igital scholars risk committing an error of omission if the conversation turns continuously to control or biopolitics at the expense of the less mediated and less technological methods of exerting power' (p. 96). The algorithms that position us as data processes operate almost identically for both marketing and security, with governments scraping private-sector databases to track 'dissidents, criminals, and provocateurs online and then arrest, deport, or torture them' (p. 111). Applying Foucauldian models of the subject-position as an effect of power and Virilio's work on scopic subjectivity and spectatorship, Hu argues that in the wake of 9/11 a new Cold War emerged, drawing upon intelligence gathered through network analysis and 'war as big data' (p. 113). As nodes within this network of power, users are interpellated then mobilized within the system as both the subjects and perpetrators of surveillance. Moreover, Hu adapts Slavoj Žižek's argument that economic and military practices of 'outsourcing' operate in identical manner, with networked military operations like extraordinary rendition exporting torture to Third World sites. Exploiting the developing world in various ways, networked capitalism thus reterritorializes violence and war within digitized liberalism. As we will see later in this chapter, 'The cloud is a subtle weapon that translates the body into useable information' (p. 142): Hu demonstrates that the sovereignty of these data is activated—in material ways—by our desire to connect to the networks

(concatenated into a singularity, ‘the cloud’), so that we supply the data, free labour and participation to the very systems that control, discipline and enact violence upon us.

The ‘datafication’ of the body within these digital systems forms the basis of Deborah Lupton’s *The Quantified Self*, which explores the phenomenon of ‘self-tracking’ that promotes self-knowledge through quantification. The term the ‘quantified self’ (QS) emerged around 2007 as a way to describe self-monitoring practices:

While the quantified self overtly refers to using numbers as a means of monitoring and measuring elements of everyday life and embodiment, it can be interpreted more broadly as an ethos and apparatus of practices that has gathered momentum in this era of mobile and wearable digital devices and of increasingly sensor-saturated physical environments.
(p. 3)

Founded by Gary Wolf and Kevin Kelly, the QS movement espouses a positivist approach to self-tracking that has generated books, articles, technologies and a dedicated website (<http://quantifiedself.com>). Lupton opens her study by outlining the ways in which digital culture has encouraged us to capture our daily lives through practices based on datafication, including lifelogging, personal analytics and the quantified self. Lupton employs the term ‘lively data’ to suggest information that is both rooted in our subjectivities and something that is itself organic and fluid. The QS movement began in earnest in 2010 and has grown in reach and popularity each year, shifting the biopolitics that underpin quantification from health professionals to personal users, especially since the enlarged take up of wearable technologies and ubiquitous computing (most notably, smartwatches and activity trackers like Apple Watch, Android Wear and FitBit). Quantification is not restricted to health and sport, but extends to offender rehabilitation, sexual and reproductive issues, workplace productivity, children’s education, even self-help programmes. At a more distended level, we can see its manifestation in core social media metrics that count Twitter followers, Facebook ‘likes’ and

Instagram shares. Quantification has also stimulated the uptake of gamification, effectively blurring the boundaries between work, play and leisure. It is important to note that, with the advent of the Internet of Things, quantification extends beyond the human body, incorporating embedded tracking devices (in domestic appliances, airports, etc.) and a range of ‘smart’ phenomena: cars, homes and cities (p. 28).

Drawing on Latourian actor-network theory and Foucauldian concepts of biopower, Lupton’s sociomaterialist core concept is that of the ‘assemblage’, which is ‘configured when humans, nonhumans, practices and discourses come together in a complex system’ (p. 40). Through such assemblages, emergent technologies become increasingly entangled with our everyday lives:

Objects are transformed through this process of incorporation, becoming endowed with a biographical meaning that is specific to the living practices and spatial contexts in which these objects are used. But it is not a one-way process—human users are also transformed by incorporation. (p. 41)

Lupton evokes (although not explicitly) concepts of cybernetics and technogenesis explored by theorists such as Norbert Wiener and Katherine Hayles, who have outlined the imbricated relationships between human and technological development, within which we function as nodes in a global transmedial circuit. Lupton locates these technocentric readings within the dynamics of capitalism and the knowledge economy, most tellingly through the notion of prosumption, in which our daily generation of data recalibrates us from subjects into users-as-products within the knowledge economy. Consequently, self-trackers understand themselves as ‘hybrid beings’ composed biologically and digitally (p. 90)—the agenda of the QS movement is to enable people to make sense of this fluidity and hybridity. Data are increasingly being perceived as more reliable than human experience, fitting into clinical developments over the last two centuries, which have increasingly prioritized the visual and

external over the haptic and subjective, as traced most famously by Foucault in *The Birth of the Clinic: An Archaeology of Medical Perception* (1963). However, authority had traditionally been vested in the medical profession, whereas QS advocates see this kind of datafication as self-liberating and user-directed. Lupton positions the emergence of the QS movement as a reaction to the openness and uncertainty of late modernity, leading to a desire for ‘ownership’ of one’s own identity—in this case embedded in the immanent materiality of the body in the QS paradigm. Self-tracking generates both expert knowledge and an algorithmic subjectivity, creating another kind of (digital) materiality, while prosthetically extending our biological selfhood as another node in the Internet of Things.

As human constructs, numbers and data carry political, legal and ethical dimensions: as such, Lupton’s study examines the risks that inhere within self-monitoring. There are clear opportunities for exploitation by third parties, such as insurance companies, employers and governments, while predictive algorithms can lead to exclusionary practices based on subjects’ health, economic circumstances and demographic backgrounds. Data harvesting at immense scale modifies conceptions of biocapital, in which the derivation of value from individuals’ bodies is supplemented by their use as ‘digital data objects’ (p. 117). While these data are offered voluntarily in many cases (through the prosumption model), Lupton identifies the risk of imposed self-tracking by insurance companies and corporate employers. A geopolitical ‘digital divide’ regarding data literacy has emerged, between those who have access to or understanding of datafication and those who do not (recent examples include the leaking of celebrities’ intimate photographs stored in the cloud and the hacking of customer accounts by cybercriminals). Our deeper immersion within these algorithmic processes exposes us to endemic systems of ‘dataveillance’, but it ‘differs from earlier modes of panoptic surveillance in that there is no centralized location from which people are watched’ (p. 60). Moreover, we become complicit in such scopic behaviours through the

‘sousveillance’ (people watching each other) encouraged by digital platforms as Facebook, Twitter, YouTube and Instagram, reshaping our attitudes to privacy:

Indeed the very rationale of such platforms is the increased levels of visibility and watching of each other that they promote. [. . .] Practices that were once considered coercive and imposed forms of state surveillance, such as biometric facial recognition for security purposes, are now routinely used in social media sites such as Facebook for the purposes of tagging others in images. (p. 61)

In the context of real and potential erosions of privacy and civil liberties, Lupton considers responses to quantification. Commentators, artists and critical makers have sought to foreground the human element of data, in the form of ‘data spectacles’, which reify data in creative and arresting ways—for instance, as beautiful images, 3D sculptures and performative multi-sensory experiences. Such engagements emphasize our affective ties to data, reinvesting the everyday with new added value, using art to encourage reflection on our condition within the neoliberal world. In these responses, the contexts of data are repeatedly emphasized—particularly, through conceptualizations of the ‘qualified self’, as ‘a practice involving reflection and the interpretation of information, whether the latter is in the form of numbers or not’ (p. 112). Other responses have entailed an emphasis on ‘small data’ as a way of regaining control and mastery of our information: ‘Small data are defined as personal and identifiable; big data as impersonal and anonymous. Small data are often represented as more contextual and easy to manage, because there are fewer data points’ (p. 131). Moving beyond atomized practices of QS for individuated self-monitoring, ‘quantified us’ initiatives aspire to reposition self-tracking as part of a civil society that shares personal data to improve communal good, leveraging big data paradigms to contextual personal circumstances in order to create a ‘rich personal ecology’ and to benefit wider society. Other campaigners are pushing for greater transparency by embedding principles of ‘open data’ and ‘personal data

philanthropy', or by encouraging 'privacy by design' (p. 137). Lupton's conclusion emphasizes the importance of data literacy, enshrining recognition of two key elements: defamiliarizing the power relations that underpin data and making transparent the commercial and governmental exploitation of our personal data.

A wider concern with quantification drives Cathy O'Neil's *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. The book offers a fascinating account of O'Neil's journey from maths professor to hedge fund analyst to data transparency activist, and nestles comfortably within a burgeoning area of technology writing aimed at the public, alongside similarly discomfiting books such as Eli Pariser's *The Filter Bubble: What the Internet Is Hiding from You* (Penguin [2012]), Sherry Turkle's *Alone Together: Why We Expect More from Technology and Less from Ourselves* (Basic Books [2012]), Jaron Lanier's *Who Owns the Future?* (Penguin [2014]) and Nicolas Carr's *The Glass Cage: Where Automation Is Taking Us* (Bodley Head [2015]). Filled with personal anecdotes and case studies, O'Neil's book takes us through the various aspects of datafication and optimization, which she argues are disenfranchizing large sections of the global population. She frames her account in the context of the 2008 global financial crisis: O'Neil had been working as a 'quant' (a quantifier) at a hedge fund company, and became increasingly aware of the way in which the financial sector was gaming the system through algorithmic predictions. Despite her personal revelations, she witnessed that quantification bounced back within two years, welcomed unquestioningly by the public. O'Neil terms these increasingly dominant algorithmic models 'Weapons of Math Destruction' (WMDs), owing to their presentation of quantification as a Hegelian truth-function: 'They define their own reality and use it to justify their results. This type of model is self-perpetuating, highly destructive—and very common. [...] Instead of searching for the truth, [quantification] comes to embody it' (p. 7).

O'Neil's study begins by outlining the increasing application by various state bodies of decontextualized data models, underpinned by the assumption that these data offer objective, neutral correctives of previous systems that might have been shaped by human flaws (racism, misogyny, class bias). However, O'Neil establishes that these models are themselves ideologically constructed, drawing on examples of algorithms that reduce human identity and behaviour into fungible Malthusian units. O'Neil's paradigmatic case involves predictive data regarding prisoner recidivism rates that have been used by judges during sentencing. The flaw is that, far from correcting human errors, these instruments incorporate into their algorithms contextual data (environmental, familial and socioeconomic factors, prior convictions) that would in other legal contexts be excluded. O'Neil identifies three aspects of such WMDs that are especially pernicious: they are opaque (the public do not understand how these algorithms operate); they increasingly function at scale across macro-social networks and their take up is likely to grow exponentially; they have the potential to cause significant social damage. O'Neil's book explores the ways in which algorithmic models are being incorporated into a range of sociocultural domains: finance, education, university admissions, marketing, policing, recruitment, employment, credit and insurance. In the education system, for instance, the efficacy of US teachers is ranked according to decontextualized data based on pupils' grades that ignore human contexts such as family structure, neighbourhood, poverty and race. Big data are being leveraged by payday loan companies or private universities, in order to profile us on a range of metrics (medical, economic, demographic) and then to target precisely the most vulnerable members of society: increasingly data-crunching machines are sifting through our data on their own, searching for our hopes, fears and desires. With machine learning, a fast-growing domain of artificial intelligence, the computer dives into data, following only basic instructions. The

algorithm finds patterns on its own, and then, through time, connects them with outcomes. (p. 75)

Predictive algorithms based on big data models are also dominating policing, yet their focus falls squarely on poor neighbourhoods, which have historically higher incidences of crime, leading to increased police activity in those areas—thus raising crime frequency data in those target neighbourhoods. A feedback loop is generated, which reinforces associations between criminality, poverty and race, while wealthy offenders evade oversight: ‘the result is that we criminalize poverty, believing all the while that our tools are not only scientific but fair’ (p. 91) Tracking recruitment and employment practices, O’Neil notes that some 72 per cent of resumés submitted by candidates in the US are automatically processed, resulting in a kind of ‘digital phrenology’ (p. 132) that means ‘[o]ur livelihoods increasingly depend on our ability to make our case to machines’ (p. 115). Credit scoring and insurance practices are eroding our privacy through the use of quantification, reinforcing the inequities of the analogue age and introducing new divisions, making humans an inconvenience in the systems that quantify them. *Weapons of Math Destruction* concludes by examining the political dimensions of social media, through which many of us not only share our experiences and opinions, but divulge volumes of data to third parties, governments and cybercriminals. Not only do corporations like Facebook glean our data, they often employ algorithms to adjust our perceptions or alter our moods. Rather presciently, O’Neil admonishes that ‘[t]he activity of single Facebook algorithm on Election Day, it’s clear, could not only change the balance of Congress but also decide the presidency’ (p. 181). The ongoing US Congressional investigations into Russian interference in the 2016 Presidential Election, as well as the role played by political data-mining/analysis companies like Cambridge Analytica in influencing voter opinions, offer provocative examples of where algorithmic quantification in the age of big data may be taking us in the coming years.

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